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Erosion

EVALUATION OF GABION STRUCTURES IN NORTH RIVER
AUGUSTA COUNTY, VIRGINIA
DRY RIVER RANGER DISTRICT
GEORGE WASHINGTON NATIONAL FOREST

Harold J. Barrett

July 1967

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INTRODUCTION

This analysis of present conditions in the North River, a tributary of the Shenandoah River on the Dry River Ranger District of the George Washington National Forest could perhaps have a more flowery introduction by saying, "Once upon a time there was a flood," and indeed the very event we speak of happened June 17-18, 1949. I hesitate to try to draw a word picture of the results immediately following. Rural and urban areas were hard hit, damage ran into the millions and lives were lost. Stories and pictures of urban and rural damage made the headlines. Regrettable was the loss of life and the damage sustained.

Now let us turn our attention to the headwaters of these navigable streams and to the damage resulting from the storm. A picture presumably is worth a thousand words, and so I have selected several pictures depicting the period from the storm to the present time.

LOCATION:

The area being considered in this report includes the northwest corner of Augusta County and the southwest corner of Rockingham County, Virginia. This report encompasses the section of North River from the City of Staunton Dam upstream for a distance of approximately 8 miles.

A survey of the entire stream from the City of Staunton Dam to the forks at the head of the river was made some 8 or 9 years ago. These recommendations were generally followed according to plan and design from the head of the river to the contour of the flood pool,

Elkhorn Lake, at Shifflett Fields, T.T. #95, Bridge #7.3, except for instances where groins were omitted and walls introduced in their place. It was determined at that time no work would be done from the bridge to the sediment pool until the dam was constructed. The reason for this was that clearing and other necessary work would change the regimen of the stream as well as anticipated bank and channel changes.

Cursory examination of bank and channel conditions this spring indicates that what we have set out to accomplish is taking place. It was noteworthy and indeed gratifying to see the channel at the forks of the river where sills had been placed some 6 years ago. The channel had stabilized itself; moss, lichens and other small vegetation was growing on the rocks and there was no indication of rubble movement in the stream bed. In one small pool a fingerling native trout was found. The gradient of the stream has been reduced and I am sure that with the construction of additional sills in the channel on down the stream, we can expect this same condition to follow. However it would be presumptious of me to say without further investigation that minor problems have not cropped up. I am sure from what I have observed and investigated that outside of initiating a program of sill installations, very little work in the form of aprons or other structures will be necessary. Where I did find additional work necessary, it was the result of lack of judgment in the turning of a bank which caused stream flow to be diverted to the opposite bank at such an angle and velocity that undercutting resulted. This, of course, could have been avoided if this was anticipated and an apron put in at the point where the stream would be tangent to the structure opposite the turned bank. One or two such problems I did investigate

along with the problem of the retention of sedimentation in the 4 cross channel weirs that were the original structures placed in the river. Lack of funds limited the scope of operations. As a result of this examination, a correction of the problem will be presented at the end of this dissertation.

It would be hard to understand that such damage could be wrought from a river after seeing its condition during the period of July and August when practically the entire stream bed is dry. A few pictures have been selected to show just what can happen if a stream is allowed to go uncontrolled.

The first picture in the flood series depicts the section of old road from Skidmore Fork to Camp May Flather that was entirely washed away and deposited in the stream channel. The other pictures are more or less self-explanatory to the extent of the havoc wrought by the stream to the banks, and choking up of channels at the bridges, and general stream conditions immediately following the flood.

We then proceed to the next phase of channel rehabilitation which in retrospect was merely the introduction of bulldozers into the channels and the dispersement of the rubble and material to each side of the channel with the hope of creating some sort of a stream bank. In reality it merely meant the creation of a "bowling alley," let alone the ignoring of the roughness coefficient of the stream which is of primary importance in the reduction of velocities, with no regard to the biological desert that was created and where, at least at the present, we can see no future use of the stream for fishing because of the destruction of the fish habitat. Wherever this material was bulldozed to the banks, it created problems not only

there but further downstream. An excellent example of just what this means can be viewed by merely standing on the bridge at Towers, Virginia and looking upstream where immediately following the flood of 1949 the Corps of Engineers introduced bulldozers and moved the material to both sides of the bank. Today this channel is again choked and trees are growing in its bed.

The next series of pictures were taken during the survey of 1959. This brings out the point previously mentioned that the material removed from the channel to the banks has again been introduced into the stream channels and the banks are again raw and eroded. Although only a few pictures have been selected, the entire length of the stream is in this condition.

To eliminate the problem, stabilize the banks, reduce stream gradients and velocities, retard rubble and stabilize stream channels, gabions have been employed.

Flood Series

T.T. #95 above the spring box near Girl Scout Camp May Flather. Road washed away. Flood damage 6/17-18/49.

T.T. #95, Bridge #7.3. Debris piled on bridge at Shifflett Fields. Flood damage 6/17-18/49.

T.T. #95, at Bridge #7.3. Cars of 4-H Club members marooned by flood. Flood damage 6/17-18/49.

T.T. #95, Bridge #7.3. Shifflett Fields flood damage 6/17-18/49.

T.T. #95, Bridge #7.3 at Shifflett Fields. Flood damage 6/17-18/49.

T.T. #95, Bridge #7.3 at Shifflett Fields. Flood damage 6/17-18/49.

T.T. #95, Bridge #8.0. Debris piled along stream bank. Flood damage 6/17-18/49.

T.T. #95, Bridge #8.0. Stream channel conditions after flood, looking downstream. Flood damage 6/17-18/49.

T.T. #95, Bridge #8.0, looking upstream from bridge. Debris and rubble in stream bed. Flood damage 6/17-18/49.

Channel Repairs
(after flood)

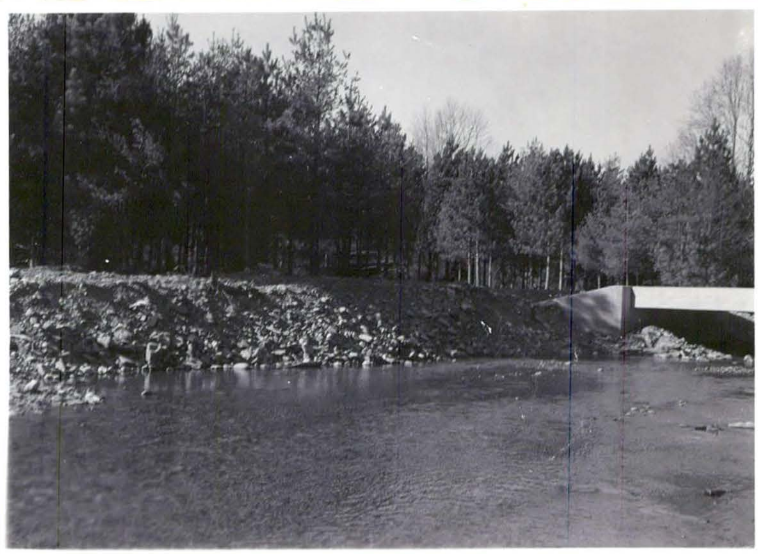
T.T. #95, Bridge #10.3. Channel clearance near Camp Todd after flood of 6/17-18/49.

T.T. #95, Bridge #8.0. Channel clearance above intersection of Lebanon Road after flood of 6/17-18/49.

T.T. #95, Bridge #8.0. Channel clearance above Lebanon Road Intersection. Repair work after flood 6/17-18/49.

T.T. #95, Bridge #10.3. Channel clearance completed repair work near Camp Todd after flood 6/17-18/49.

T.T. #95, Bridge #8.0. Channel clearance above Lebanon Road Intersection. Completed repair work of flood 6/17-18/49.

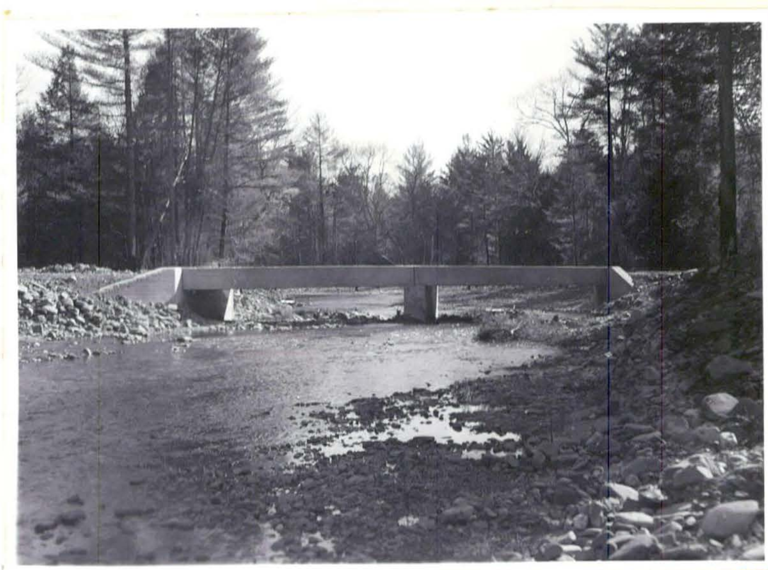


T.T. #95, Bridge #7.3. Completed repair work near Shifflett Fields after flood 6/17-18/49.

T.T. #95, Bridge #7.3. Completed repair work after flood of 6/17-18/49. At Shifflett Fields.

T.T. #95, Bridge #8.0. Above Lebanon Road Intersection. Repair work after flood of 6/17-18/49.

T.T. #95, Bridge #7.3. Completed repair work at Shifflett Fields after flood 6/17-18/49.



T.T. #95, Bridge #10.3. Completed repair work after flood of 6/17-18/49. Near Camp Todd.

T.T. #95, Bridge #10.3. Completed repair work after flood of 6/17-18/49, near Camp Todd.

Channel Conditions
1959 Survey

Condition of Banks Prior to Installations

Material from Bank Being Introduced to Stream Channel

Location of Gabion Wall #26. On left bank 55 ft. downstream from Sta. #312 + 49.

Location of Gabion Wall #28 near Sta. #278 + 73 on right bank.

Before Gabion Installation

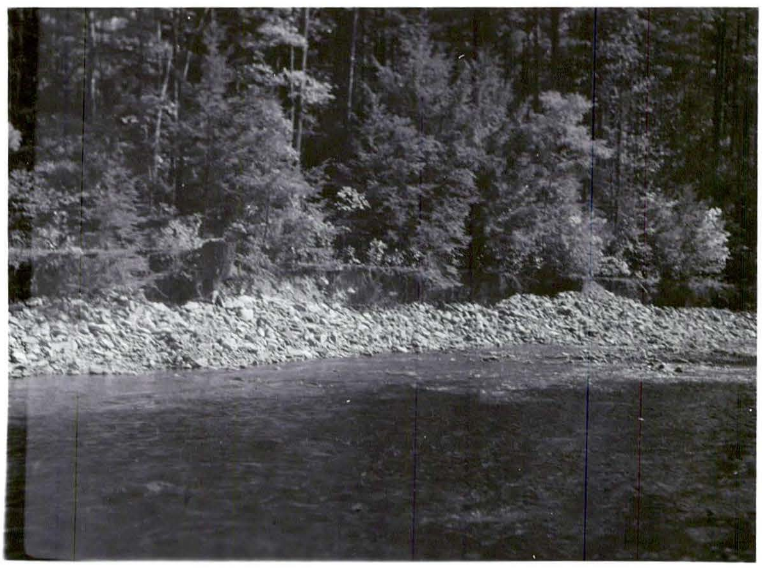
Weir #4, Wall #21 near Camp Todd. Taken looking upstream, 77 ft. downstream from Sta. #341 + 19. Bank and stream conditions prior to installations.

Cross Channel Weir #4 and Wall #21. Picture shows bank conditions.

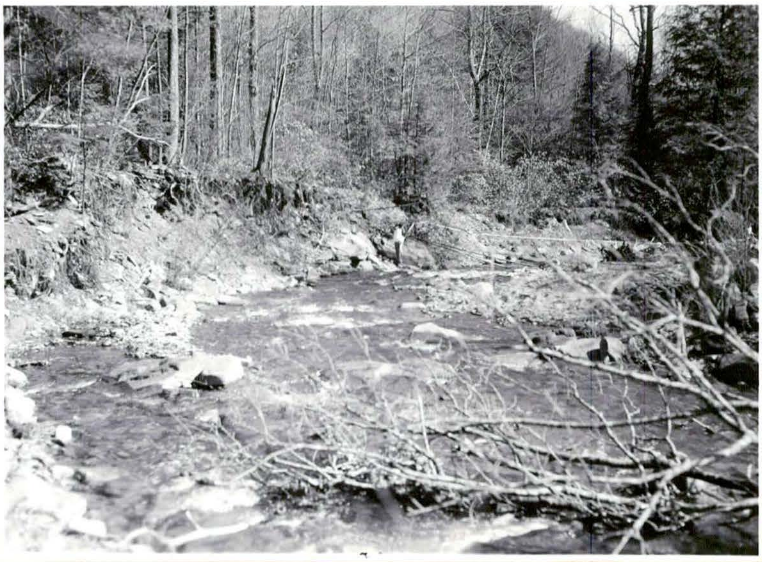
Gabion Wall #2A, near Bridge #13.5, T.T. #95
at the confluence of North River and Big River.
Looking downstream, this shows stream and bank
conditions prior to gabion installations.

Cross Channel Weir #1, at Sta. #115 + 82.
Looking downstream with Bridge #8.0 and
T.T. #95 in background.

Cross Channel Weir #2 at Sta. #154 + 02, showing the right bank of stream.



Wall #3, showing condition of bank looking downstream.



Wall #4A near Bridge #13.0, T.T. #95. Picture taken from bridge looking upstream and shows channel and bank conditions prior to installation.

North River - Channel condition prior to dam construction. Below Shifflett Fields at Bridge #7.3, T.T. #95.

North River below Bridge #7.3, T.T. #95.
Channel condition prior to dam construction below Shifflett Fields.

North River below Bridge #7.3, T.T. #95.
Bank condition prior to dam construction below Shifflett Fields.

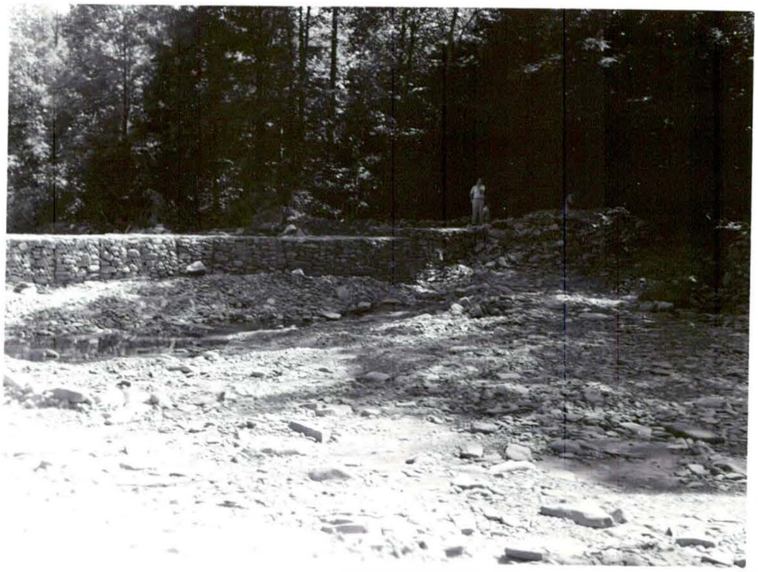
Gabion Installations
Completed and Under
Construction

During Construction and Completed Structures

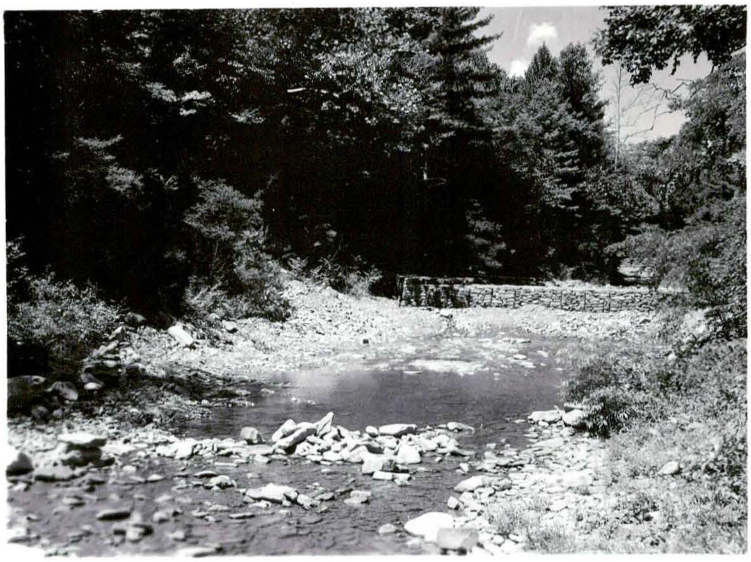
Cross Channel Installation #1 during construction.

Cross Channel Weir #1 after completion of installation. Bridge #8.0, T.T. #95, in background.

Cross Channel Weir #2 during construction. Picture taken looking upstream.



Cross Channel Gabion Weir #3, near Camp Todd. Picture taken during construction of upstream side of weir.



Cross Channel Gabion Weir #3 showing completion of structure. Picture taken from upstream side.

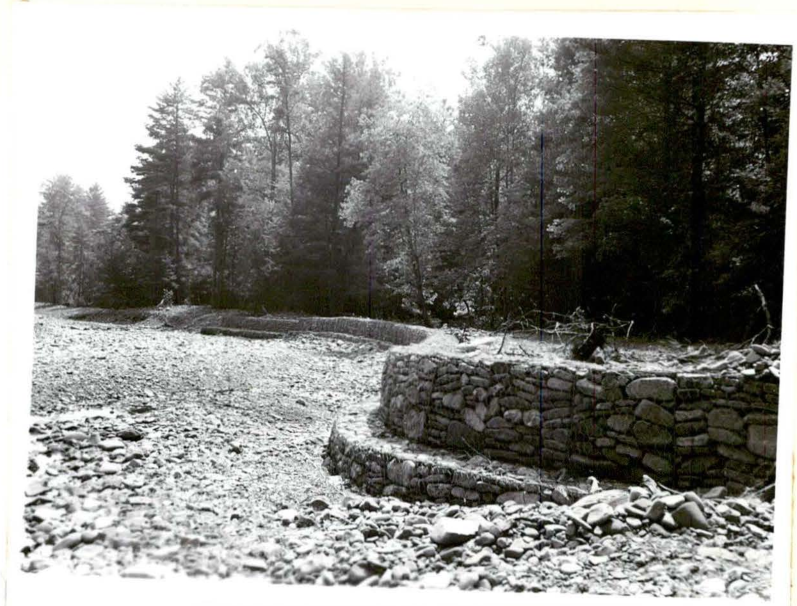
Gabion Weir #3 shows Byron Beatty and Sergio Lavagnino standing on top of structure.

Under Construction and Completed

Groin #1, Sill #2. Picture taken looking upstream, 160 ft. south of Sta. #419 + 30. Near head of the river.

Groin #1, Sill #2. Picture taken looking downstream, 160 ft. south of Sta. #419 + 30, near head of the river.

Completed Structures



Wall #73, completed. Right bank of stream Sta. # 174 + 18. Picture shows completed structure looking downstream.

Wall #74. Picture shows completed structure and the end of wall looking downstream.

Wall #74. Completed structure on left bank looking downstream. Wing-walls were installed in side channel.

Wall #75. Shows completed structure on right bank looking downstream.

Wall #76. Shows completed structure on left bank looking downstream.

Gabion Sill #1. Picture taken from right bank showing upstream side of sill during construction.

Gabion Sill #1. Picture taken standing in center of CCS #1, looking upstream with T.T. #95, Bridge #13.5 in background.

Cross Channel Gabion Weir #4, showing completion of structure. Picture taken from downstream side near Camp Todd.

Cross Channel Gabion Weir #3 completed. Picture shows downstream side of structure.

Weir #2 near Bridge #8.0, T.T. #95.

Head of North River. Wall #1A in foreground and
Wall #2A in background.

Wall #75 in foreground. Wall #76 in background.

T.T. #95, Bridge #8.0. Completed installation of Gabion #4 for protection of abutment.

Groin #2. This is 140 ft. upstream from Sta. #415 + 03, near head of North River.

Wall #21 with cross channel weir at
Sta. #341 + 19 on T.T. #95 and above
Bridge #11.7.

Repair Work

REPAIR WORK

It is noteworthy that on March 11, 1958, the following recommendations were made regarding the North River Rehabilitation Project.

Where does quote end? oaz

"Future proposed work on the rehabilitation of North River envisions the construction of retarding structures cross channel to eliminate the movement of bed load downstream and to stabilization of the stream bed.

It is proposed to construct 2 weir type structures across North River above Bridge #8.0, FH #95.

The distance across channel is approximately 170 feet. The distance between weirs will be 150 feet.

The average bankful velocity computed by the Manning Formula $\left(v = \frac{1.5\ r\ 2/3\ s\ 1/2}{N}\right) = 3.5$ ft/sec.

The average slope of the reach is 1.5% and the channel n value was chosen as 0.10.

These figures produce an average bankful discharge of 1050 cfs for the reach.

It is proposed to also construct 2 weir type structures across North River near Camp Todd.

The distance across channel is approximately 100 feet. The distance between weirs will be 150 feet.

The average bankful velocity computed by the Manning Formula for this reach is $\left(v = \frac{1.5\ r\ 2/3\ s\ 1/2}{N}\right) = 4.5$ ft/sec.

The average slope is 1.5% and the channel n value was chosen as 0.075.

These figures produce an average bankful discharge of 1125 cfs

Weir #2. Conditions around Weir #2 above T.T. #95, Bridge #8.0, are depicted in the pictures. On the left bank looking upstream above Weir #2 we find erosion of the bank taking place. To eliminate this problem a wall 10 meters long (32.8 ft.) along the bank and tied to the weir to protect this area from further erosion should be installed.

Weir #1. To eliminate the problems created at Weir #1, an extension of the wing-walls a total of 60 feet above and below the structure should be installed. This will create on the left bank a more or less revetment to facilitate the flow of water during high periods.

The installation of these weirs were originally for the purpose of retaining the sedimentation that was moving downstream. Their action can be explained as being created for the same purpose as that of a sediment pool. The retardation of this material is essential if we ever anticipate or expect to stabilize channels, reduce gradient and channel velocities. At the same time we are expecting that we will be able to increase the roughness coefficient of the stream. The alternative would be to move this sediment every few years, which is not the answer we are looking for. There is also the possibility of bulldozing this material to each side of the stream channel creating a bank, which was originally done. If however, this alternative is followed it should be borne in mind that to eliminate this material from again entering the stream channel a wall should be introduced to retain the material at the bank.

Wall #75. This wall was erected in 1965. The slippage caused in this structure was due to the extension downstream of Wall #74

which diverted the stream directly into Wall #75 at this point which was tangent to the stream flow. To correct this problem a revetment ½ meter high and 88.5 feet long should be placed on top of the present structure in the area where slippage is taking place. At the same time an apron should be placed along the present area where the structure is slipping into the stream. This should be woven to the present structure instead of being tied with the twister.

The material in the channel at the present time should be moved to the right bank and the material at the end of Wall #75 should be moved to the left bank. For complete protection a 100 ft. extension of Wall #74, which was constructed in 1964, should be considered. This will bring it down to the present ford across the river.

At the end of Wall #75 there is an ideal location for a sill 1 meter high with wing-wall. At the end of Wall #76 there is also an ideal location for a 1 meter high sill to be placed for the retention of rubble and sediment.

Wall #47. This wall was constructed in 1962. It needs an extension upstream of approximately 50 ft. with a revetment of 45 ft. on top of the wall. This extension is approximately 4 meters long.

Some individuals have expressed concern over the deterioration of the gabions. We will soon be approaching the ten-year period of their use. Most of the concern is centered around the gabions that extend across the channel and are known as Weirs #1, #2, #3, and #4. Fear is expressed that they will give way and the sediment and rubble material behind the structures will be washed downstream.

The original construction of these cross channel weirs is such that actual undercutting of the cross channel structure is practically impossible. This is due to the depth the foundation was placed in the original construction. In fact, an apron on Weirs #1 and #2 in all probability could be eliminated and no material effect would be discerned.

It must be remembered that abrasion of any degree, be it in suspension or actual movement of rubble, will eventually remove any thickness of galvinizing and when this material is removed it is expected that rusting will take place. This in itself does not mean that there is going to be a collapse of the structure or that a dire emergency is about to take place.

If there is a substantial amount of sediment in suspension flowing over or passing by the gabion structures, as well as rubble movement continuing on downstream and over such structures, it is only natural that this movement will remove any galvinization, regardless of its thickness. Rust in itself is not necessarily a complete breakdown of a product.

Gabions are constructed in such a way that regardless of wherever a break occurs it is a simple matter to re-weave sections in the break and maintain its efficiency. Even though any one meter of a

basket should be broken, the remaining structure can still carry on the function that it was intended to do. All wire used in the construction of gabions exceeds all federal specifications.

The estimated cost of the repairs to the structures investigated is tabulated below. In all probability these are rather high and repairs should go along smoothly because of their general location and accessibility. It is also anticipated that even though a value was placed on the use of heavy equipment, we do not see the need or necessity of using heavy equipment on the sites themselves but only to assure that there will be sufficient amount of filling material on hand. The least amount of use of such equipment I find in the stream bed the better off the channel will be. We can also anticipate a reduction in the cost of installations as rapidly as the men catch on to the procedures to be used.

A greater emphasis should be placed on the elimination of an excessive amount of heavy equipment when it is not necessary. It is perfectly justifiable to merely level off the site where a structure is to be erected, and this can often be done by hand labor.

However, in constructing walls and other structures of this nature it is of primary importance that we adhere and insist on the installation of a properly functioning apron. The apron should not be of a thickness too great to sacrifice flexibility and also to assure ourselves of its proper function, the material introduced in the aprons should be only a little larger than the mesh itself. The fill material would be preferably of a rounded nature to avoid cutting of the wire during its bending process.

REPAIR COSTS

WEIR #1 - GABIONS

QUANTITY	SIZE	UNIT COST	TOTAL COST	(LBS) WEIGHT	TOTAL FREIGHT	GRAND TOTAL
4	4 x 1 x .5	$19.51	$ 78.04	300	$4.20	
3	3 x 1 x .5	15.06	45.18	165	2.80	
			$123.22		$7.00	$130.22
Supervision and Labor						75.00
Equipment:						
Light	$10.00					
Heavy	60.00					
	$70.00					70.00
		TOTAL COST WEIR #1				$275.22

WEIR #2 - GABIONS

QUANTITY	SIZE	UNIT COST	TOTAL COST	WEIGHT (LBS)	TOTAL FREIGHT	GRAND TOTAL
2	4 x 1 x 1	$26.38	$52.76	200	$2.80	
1	2 x 1 x 1	14.50	14.50	55	1.40	
			$67.26		$4.20	$ 71.46
Supervision and Labor						75.00
Equipment:						
Light	$10.00					
Heavy	60.00					
	$70.00					70.00
			TOTAL COST WEIR #2			$216.46

WALL #47 - GABIONS

QUANTITY	SIZE	UNIT COST	TOTAL COST	WEIGHT (LBS)	TOTAL FREIGHT	GRAND TOTAL
4	4 x 1 x 1	$26.38	$105.52	400	$5.60	
3	4 x 1 x .5	19.51	58.53	225	4.20	
1	2 x 1 x .5	10.65	10.65	55	1.40	
			$174.70		$11.20	$185.90
Supervision and Labor						75.00
Equipment:						
Light	$10.00					
Heavy	60.00					
	$70.00					70.00
			TOTAL COST WALL #47			$330.90

WALL #74 - GABIONS

QUANTITY	SIZE	UNIT COST	TOTAL COST	WEIGHT (LBS)	TOTAL FREIGHT	GRAND TOTAL
7	4 x 1 x 1	$26.38	$184.66	700	$ 9.80	
1	3 x 1 x 1	20.86	20.86	80	1.40	
			$205.52		$11.20	$216.72
Supervision and Labor						75.00
Equipment:						
Light	$10.00					
Heavy	60.00					
	$70.00					70.00
			TOTAL COST WALL #74			$ 391.72

WALL #75 - GABIONS

QUANTITY	SIZE	UNIT COST	TOTAL COST	WEIGHT (LBS)	FREIGHT TOTAL	GRAND TOTAL
6	4 x 1 x .5	$19.51	$117.06	450	$7.00	
1	3 x 1 x .5	15.06	15.06	55	1.40	
			$132.12		$8.40	$140.52
Supervision and Labor						110.00
Equipment:						
	Light	$10.00				
	Heavy	120.00				
		$130.00				130.00
(Apron)						
6	4 x 1 x .3	$16.46	$ 98.76	360	$5.60	
1	1 x 1 x .3	12.93	12.93	45	1.40	
			$111.69		$7.00	118.69
		TOTAL COST WALL #75 (Apron and Revetment)				$499.21

As previously mentioned in the report, we think it is advisable to set up in the near future a resurvey of the structures already installed and at the same time to stake out those sites deemed preferable for the installation of sills, which in themselves will materially affect the gradient and velocity of the stream. In the installation of these structures foresight should be used so that any improvements such as bridges and roads will not be materially affected during high water. It is also advisable to give thought, now that the Elkhorn Lake Dam is in place, to the need for a stream survey from T.T. #95, Bridge #7.3 to the sediment pool. These structures will be in the flood pool which was created for a 50 year flood stage.

The average estimated cost for a sill, installed, will amount to $350.00. The Maccaferri Gabions of America, Inc., having originally initiated this project, is very much interested and concerned with its progress and will be more than delighted to assist in any way in the survey and design of any structures deemed advisable.

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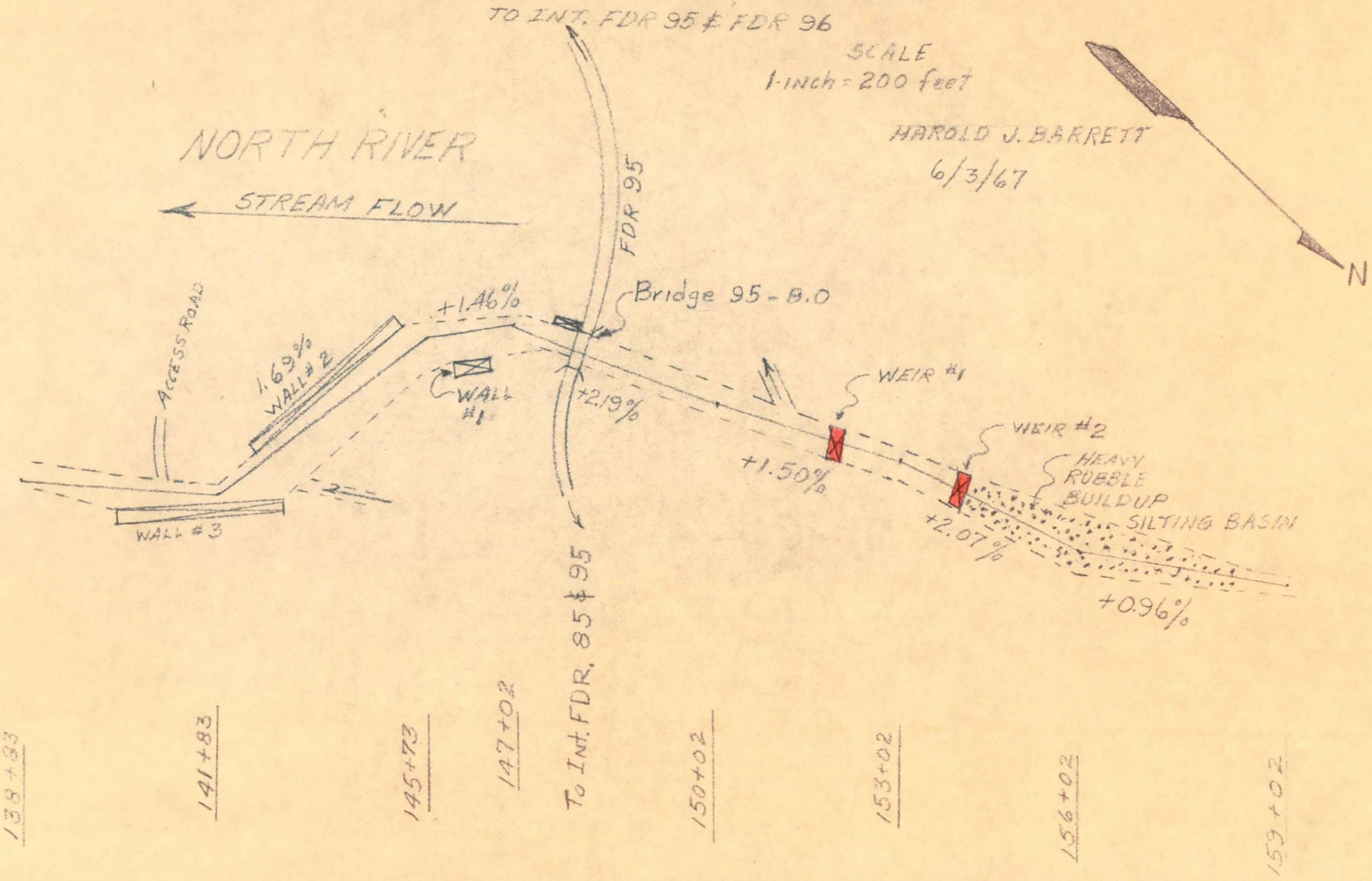
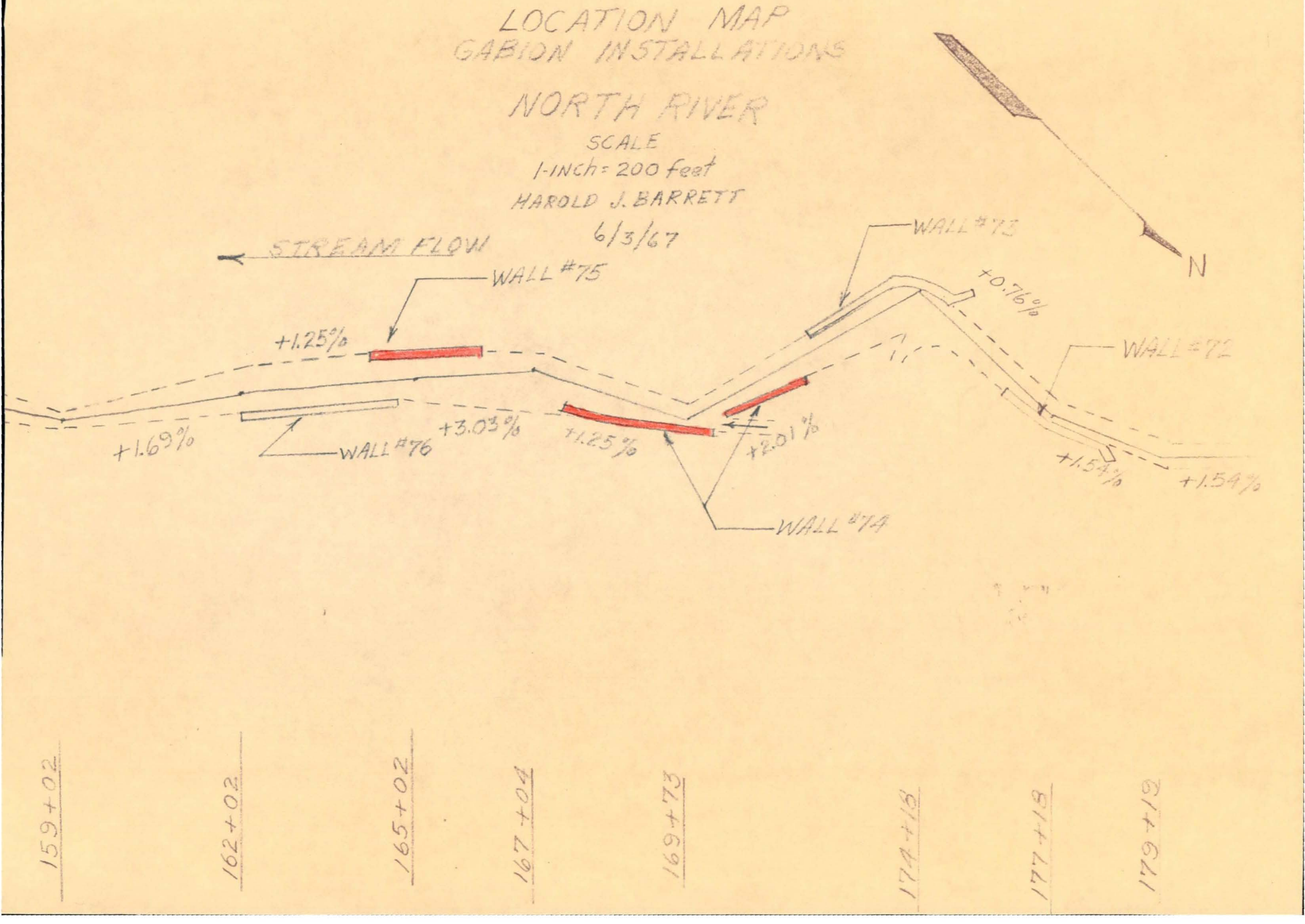
LOCATION MAP
GABION INSTALLATIONS



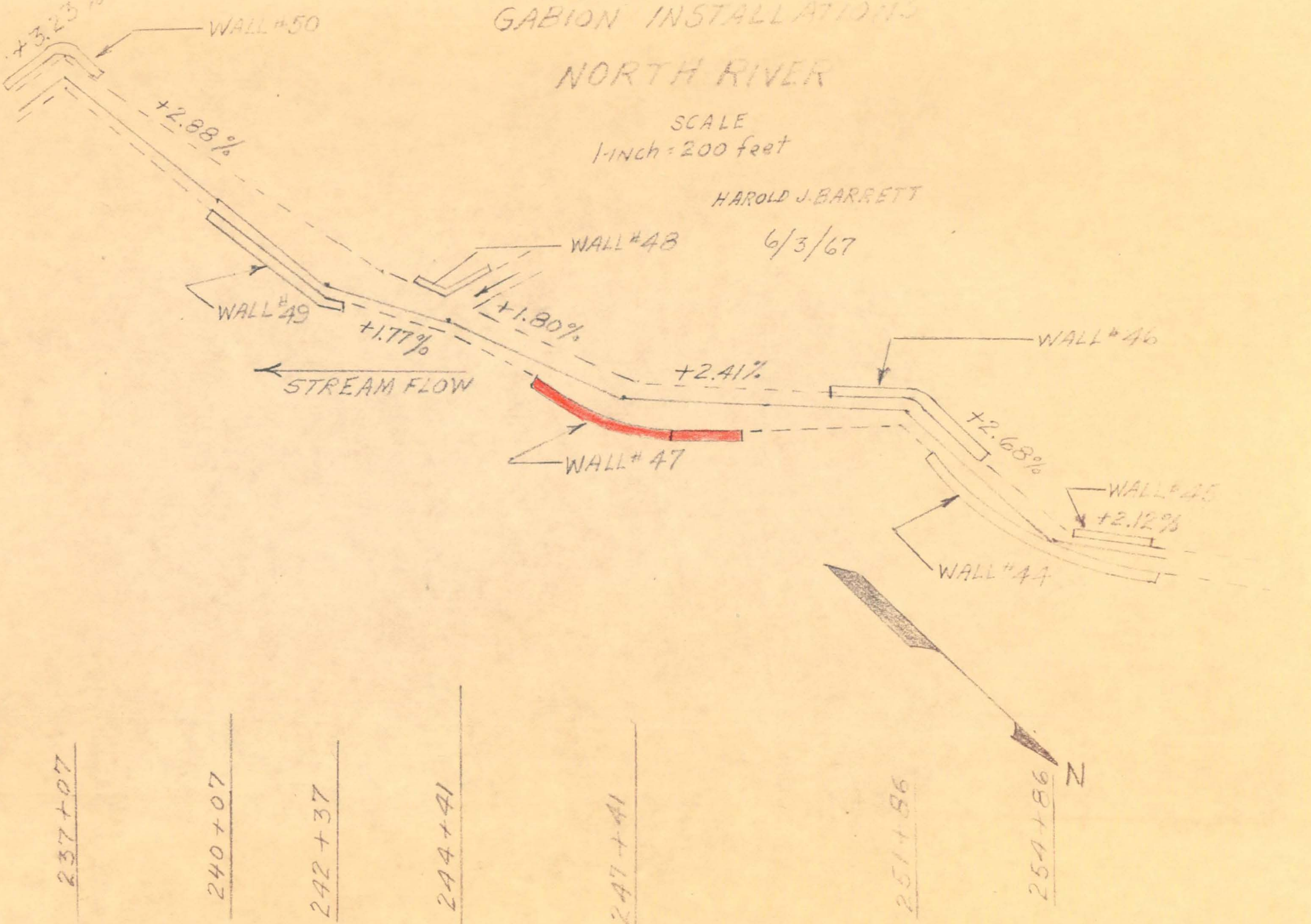

LOCATION MAP
GABION INSTALLATIONS
NORTH RIVER
SCALE
1-INCH = 200 feet
HAROLD J. BARRETT
6/3/67
STREAM FLOW
N
WALL #73
WALL #75
WALL #72
WALL #74
WALL #76
+0.76%
+1.25%
+1.69%
+3.03%
+1.25%
+2.01%
+1.54%
+1.54%
159+02
162+02
165+02
167+04
169+73
174+18
177+18
179+19

LOCATION MAP
GABION INSTALLATIONS
NORTH RIVER

SCALE
1-inch = 200 feet

HAROLD J. BARRETT

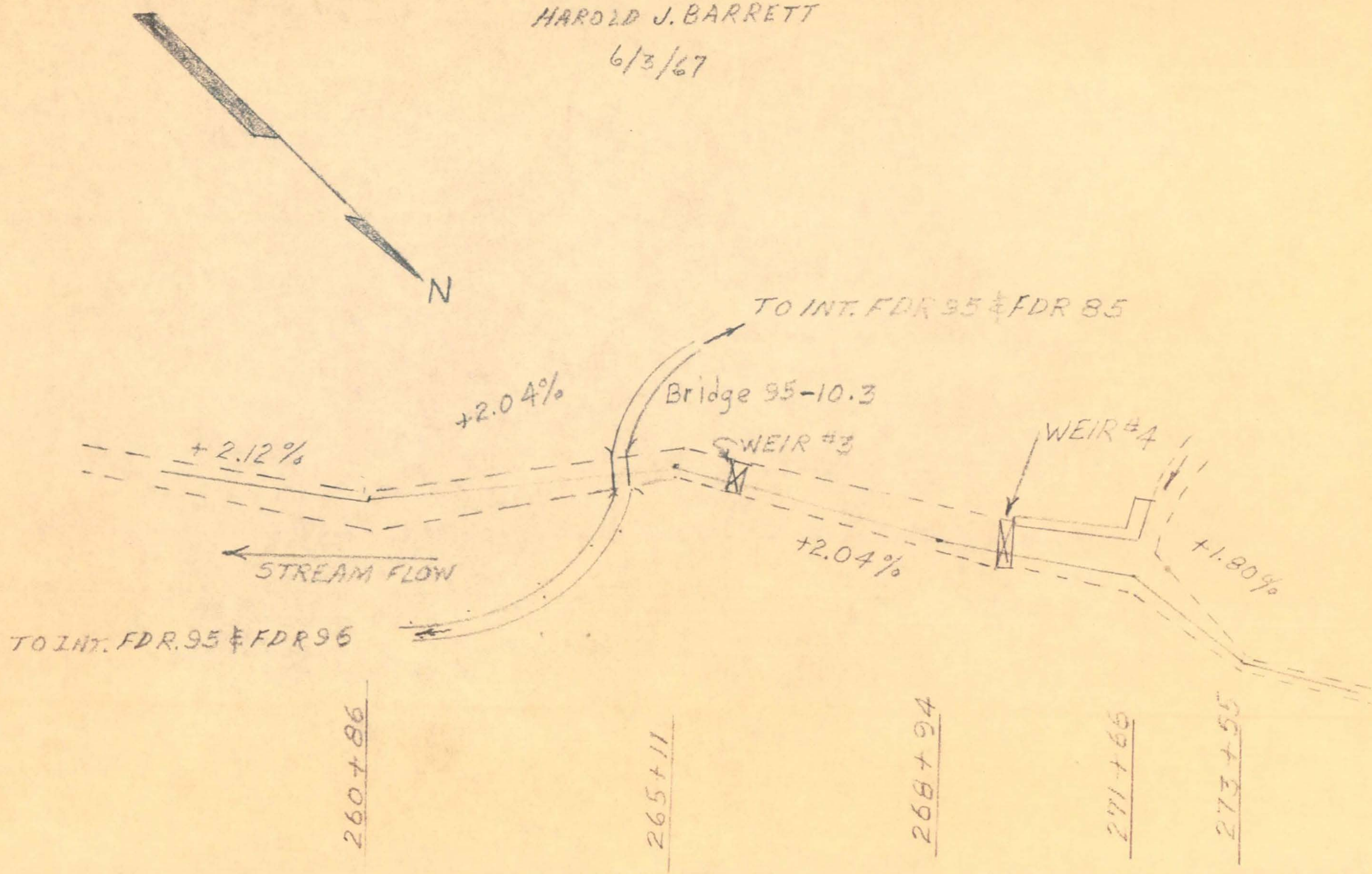
6/3/67



LOCATION MAP
GABION INSTALLATIONS

NORTH RIVER

SCALE
1-INCH = 200 feet
HAROLD J. BARRETT
6/3/67



Sediment in stream and lagoon looking upstream from Weir #2.

Wall #75 has slidden out of position.

On left bank, looking upstream above Weir #2.

Sediment deposit, looking upstream from Weir #2.

Fisherman standing on apron of Weir #2. This is on left bank looking upstream.

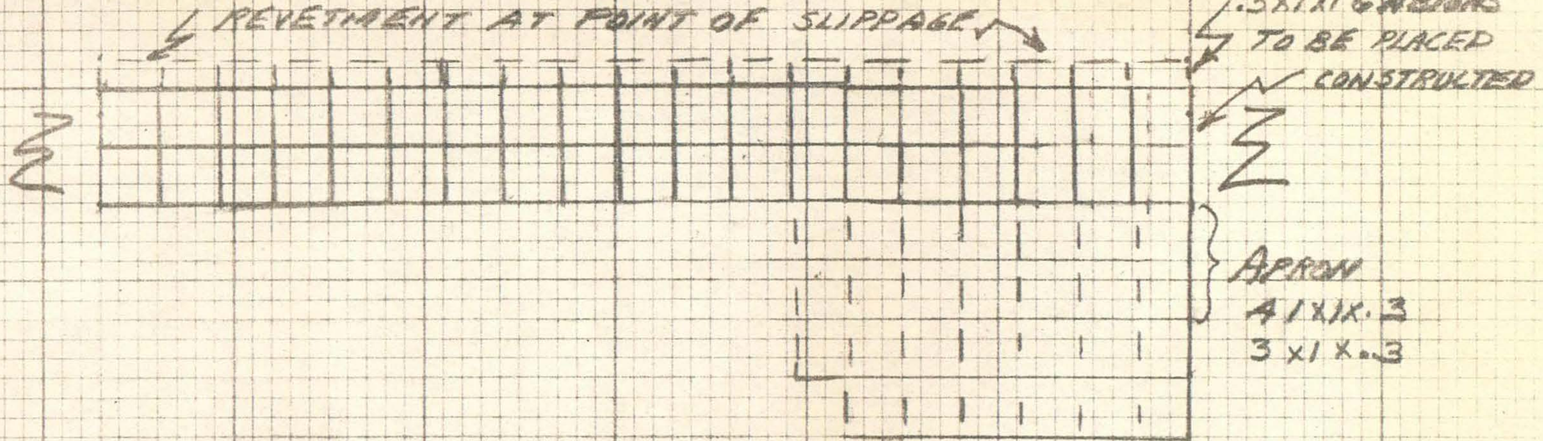
Fisherman on apron of Weir #2. Shows the left bank being cut.

Looking downstream with Weir #2 in background.

Looking upstream from right bank of Weir #2.

Wall #47 is located on the right bank of the river at Sta. #247 + 41 and extends upstream with the contour of bank a distance of 73 feet. There has been a slippage of the upstream end of the wall and to correct this the wall should be extended 50 feet with a revetment.

REPAIR WALL # 75
JULY - 1967



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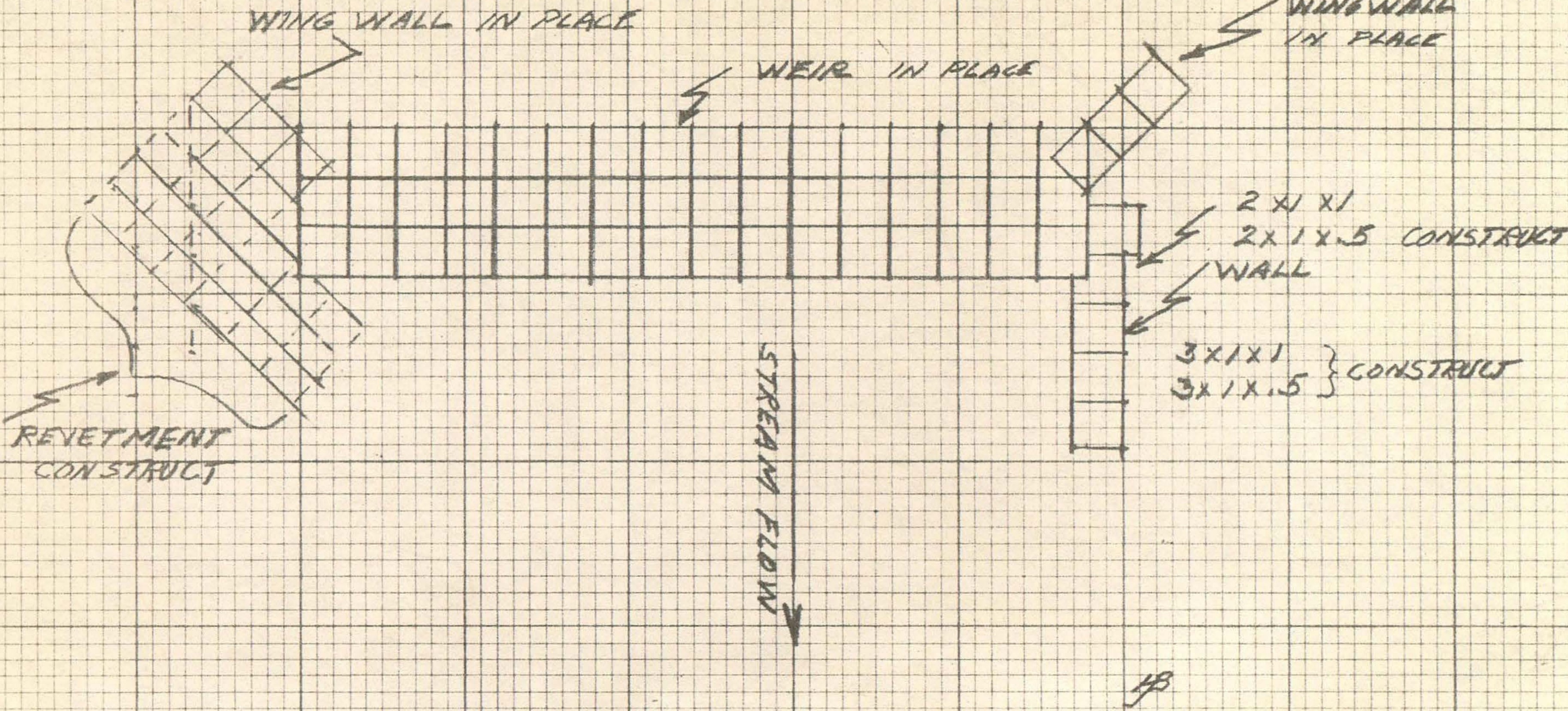
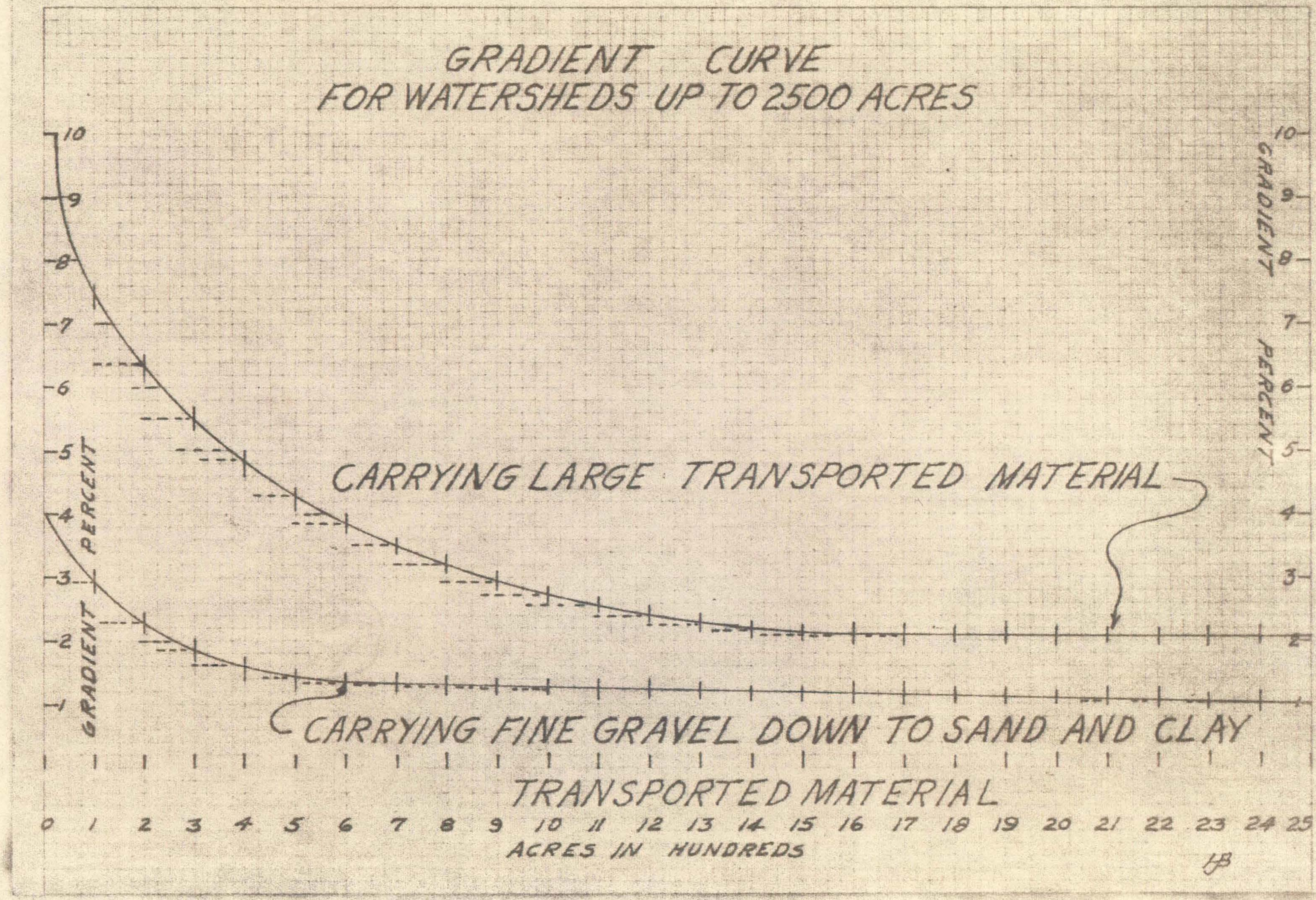
REPAIR WORK - WEIRS 1 & 2

JULY 1967




GRADIENT CURVE
FOR WATERSHEDS UP TO 2500 ACRES
CARRYING LARGE TRANSPORTED MATERIAL
CARRYING FINE GRAVEL DOWN TO SAND AND CLAY
TRANSPORTED MATERIAL
GRADIENT PERCENT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
ACRES IN HUNDREDS
1 2 3 4 5 6 7 8 9 10
HB

NORTH RIVER PILOT HYDROLOGIC STUDY
GEORGE WASHINGTON N.F. DRY RIVER R.D.
AUGUSTA CO. VIRGINIA
STRUCTURAL INSTALLATION MAP
LEGEND
Stream
Watershed Boundary
95 Road
Gabion Structures
Other Structures
SCALE
4-inches = 1-mile
14,976 ACRES
38°28'
19'
18'
17'
16'
79°15'
27'
26'
25'
24'
23'
22'
21'
38°20'
79°19'
15'
Reddish Knob
BM 4397
85.6
Shenandoah F.C.
Well
Spring
H.J. Barrett
WEST VIRGINIA
VIRGINIA
River
SHENANDOAH MOUNTAIN
BM
3659
BM
2979
BM 3058
STATE 32
PENDLETON CO.
HIGHLAND CO.
W. VA.
VA.
95
North
Brushy Mt.
BM
2708
AUGUSTA CO.
HIGHLAND CO.
Wall-2A
Wall-1A
Still
Groins-1-2
Wall-3
3A
Wall-4
Wall-5
Wall-6
Groins-3-4-5
Wall-7
Wall-8
Groins-6-7
Little Bald
Knob
4320 ft.
Wall-10
Groins-8-9-10
Siple
Spring
Wall-11
Wall-12
Groins-11-12-13-14
Wall-13
Wall-14
Wall-15
Wall-16
Wall-17
Wall-18
Weir-1
Weirs-2-3
Not placed
Wall-19 Not placed
Trout Run
Wall-20
Weir-4
Wall-21
Groin-15
Wall-22
Wall-23
Wall-24
Wall-25
Wall-26
Wall-27
Wall-27A Replaced Weirs-5-6
Wall-27B Replaces Groins-16-21 inc.
Spring House Ridge
Camp
Todd
Well
Wall-28
White Oak
Knob
3640 ft.
Tearjacket
Knob
4200 ft.
Hardscrabble
Knob
Weir-4
Weir-3
95A
Wall-29
BM
2306
Wall-44
Wall-45
Wall-46
River
Wall-47
Old
Settlers
Grave
Wall-48
Wall-49
Wall-50
Wall-51
Wall-52
Wall-53
Wall-53-A
Wall-54
Wall-56
Groins-29-30-31
Wall-56
Wall-57
Wall-58
Groins-32-33
Wall-59
Wall-60
Wall-61
Wall-62
Wall-63
Wall-64
Wall-65
Wall-66
Wall-67
Wall-68
Wall-69
Wall-70
Wall-71
Wall-72
Wall-73
Wall-74
Wall-75
Wall-76
Weir-2
Weir-1
Wall-4
Wall-1
Wall-3
Wall-2
Wall-77
Wall-78
Wall-79
4060 ft.
Bald Knob
Still House Cr.
Flat Run
Mitchel Branch
Oak Run
96.2
White
BM 2122
Stream
Gage
LAT. 38°20'15"
LONG. 79°14'25"
ELEV. 2054.57'
575' UPSTREAM ABOVE
HIGHWAY BRIDGE
Hankey Mtn.
Hankey Mtn.